



Jet Propulsion Laboratory
California Institute of Technology

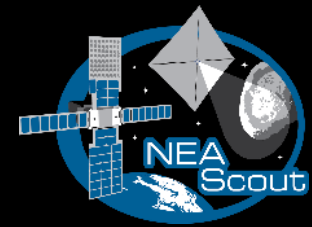


Near Earth Asteroid (NEA) Scout CubeSat Mission

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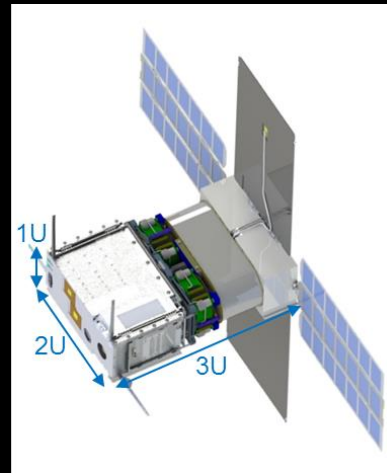
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NEA Scout Mission Overview

- Mission Objectives:
 - Characterize one candidate NEA with an imager to address key Strategic Knowledge Gaps (SKGs)
 - Global and regional morphology
 - Rotational properties
 - Local debris environment
 - Regolith properties
- One of “Lucky 13” CubeSats launching on Space Launch System EM-1 (~2019)
 - Demonstrating deep space navigation with 86-m² solar sail
 - 6U CubeSat
 - 2.5 year design mission life
- Collaborative Mission
 - MSFC provides solar sail, ACS/GNC, and mission operations; implements spacecraft I&T
 - JPL provides avionics, mission design and navigation, and instrument (camera)
 - Support from GSFC, JSC, LaRC



“U” ~10 cm cube

Target Reconnaissance with medium field imaging
Shape, spin, and local environment



Close Proximity Imaging
Local scale morphology, terrain properties, landing site survey



NEA Scout Science Overview

Close Proximity Science
High-resolution imaging,
10 /px GSD over >30% surface
SKGs: Local morphology
Regolith properties



JPL Camera
(Updated OCO-3
Context Camera)

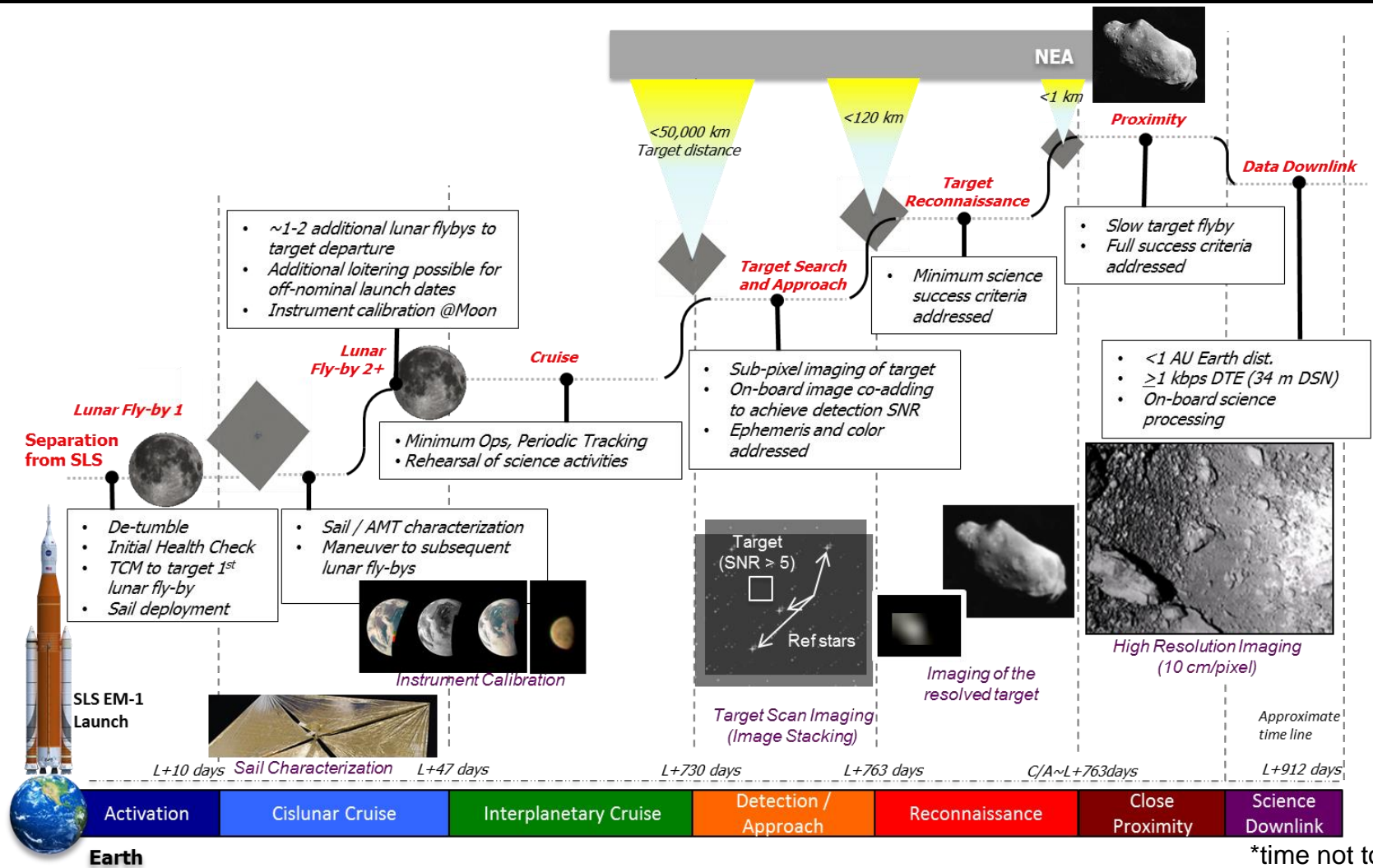
NEA Reconnaissance

<100 km distance at encounter
50 cm/px resolution over 80% surface
SKGs: volume, global shape, spin
properties, local environment



Target Detection and Approach:
50K km, Light source observation
SKG: Ephemeris determination

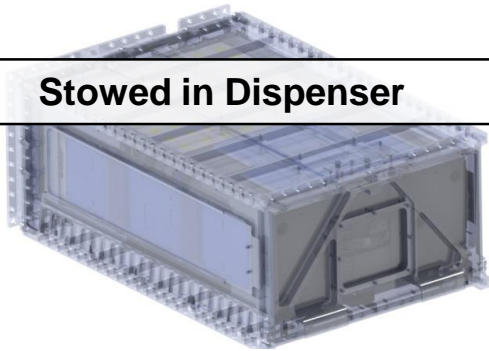
Concept of Operations



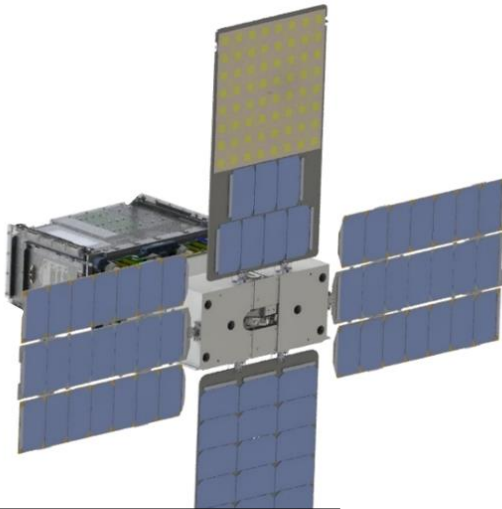
*time not to scale

NEAS Deployment Configurations

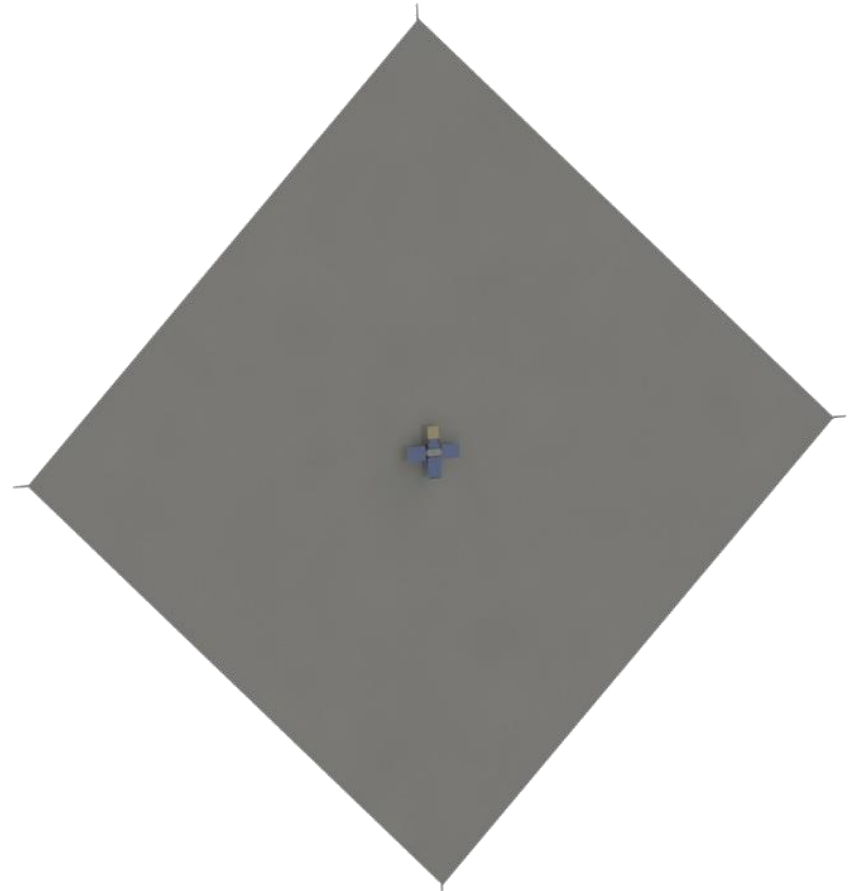
Stowed in Dispenser



After solar panel deployments,
before sail deployment

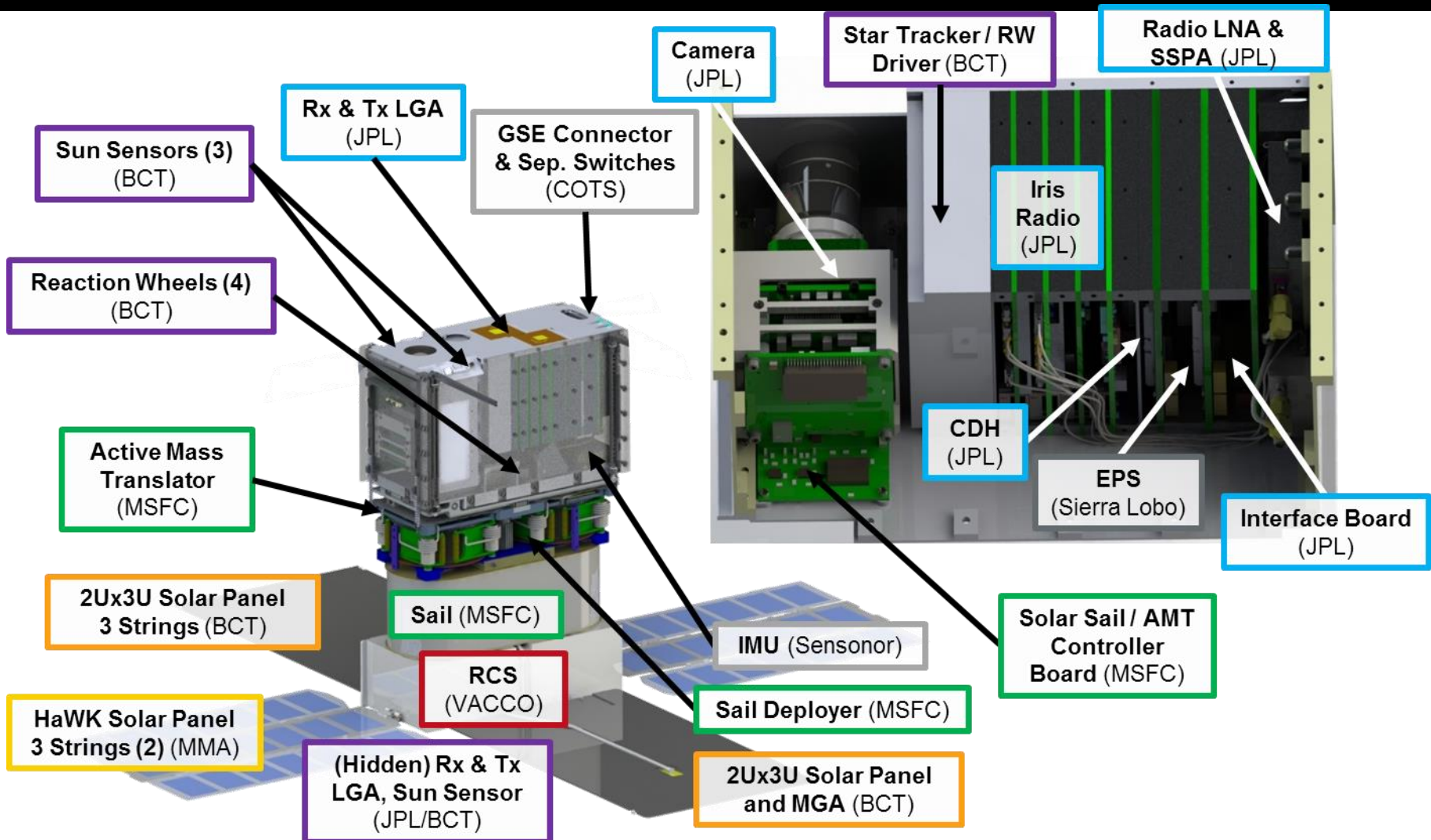


Sail deployed



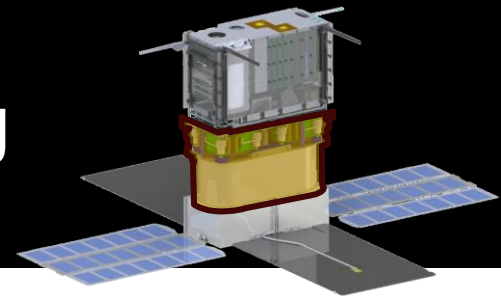
NEAS Flight System Overview

Combination of COTS and In-House Development

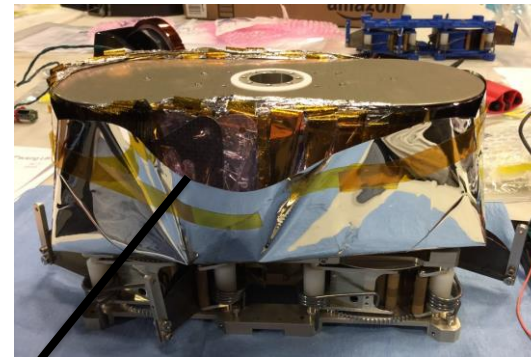


Tests and Development Activities

Sail and AMT Environmental Testing



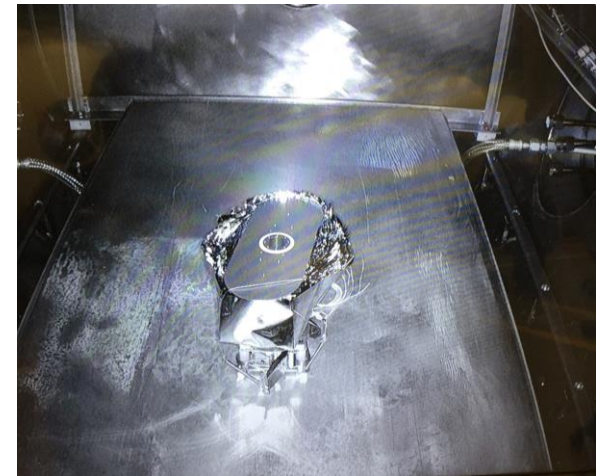
- Uncover and address technical and process challenges early-on
- Sail deployment tests (half-scale and full-scale)
- AMT benchtop functional tests
- Vibration test
- Depressurization test



Full-scale Assembly (non-Flight)

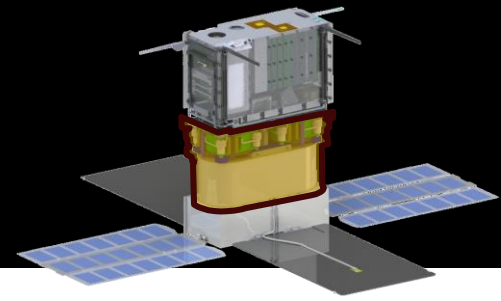


Vibration Test Fixture

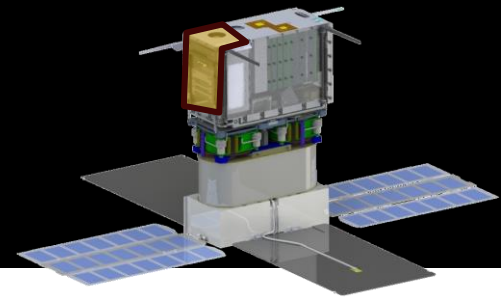


Ascent Vent Test

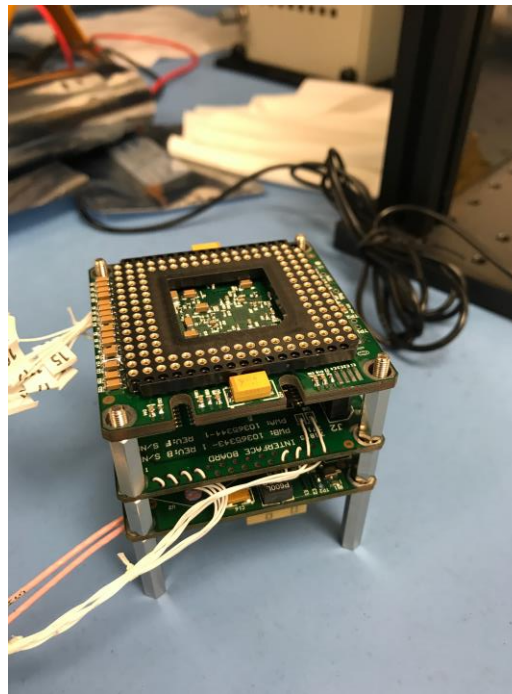
Sail EDU Deployment Testing



Camera Assembly and Testing



- Flight Camera has seen first light!
- Electronics boards assembled and tested
- Mechanical housing assembled
- Environmental testing
 - Bakeout
 - Vibration



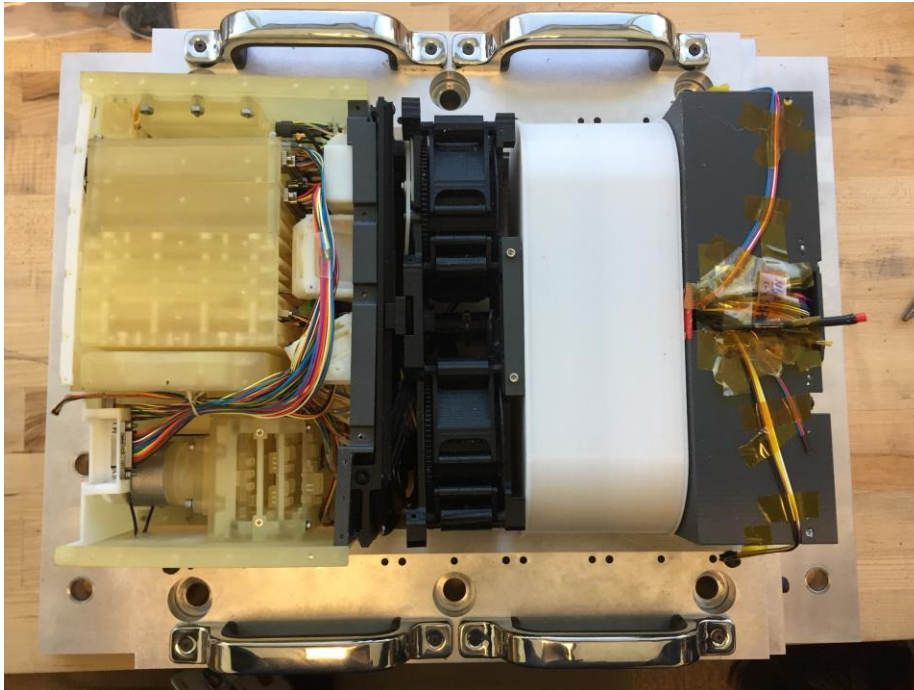
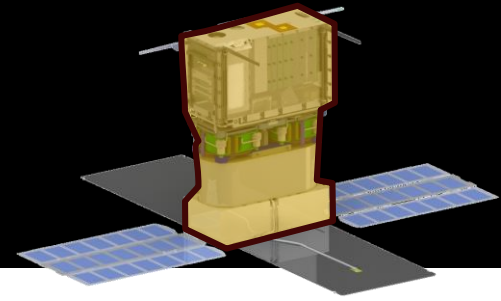
Inner electronics stack



Mechanical housing

3-D Mockup Activity

- Component fit/tolerance check
- Practiced wire routing (risk reduction)
- Informed procedures for assembly, integration, harnessing

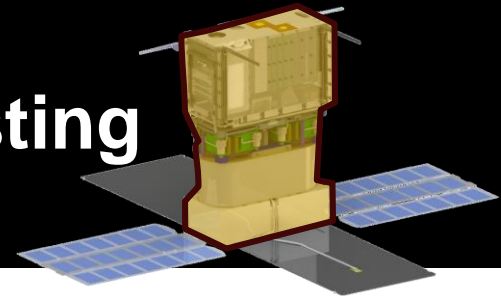


Integrated 3-D Print



Checking out AMT translation

Software Development and EDU Testing



- ‘FlatSat’ software development and limited functional testing
 - Assemble hardware as available
- Development units and engineering models currently in-hand
 - Will be arriving into Fall 2017
- Development will continue through system I&T
 - Software development in parallel with hardware integration

Summary and Project Status



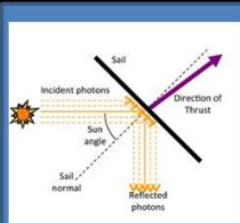
- Summary
 - NEAS is demonstrating new, enabling technology and addressing strategic knowledge gaps in a 6U CubeSat form factor
 - Solar sail
 - Momentum management – Active Mass Translator
 - Deep-space transponder (Iris), rad-hard electronics (Sphinx)
 - Collaboration between several NASA centers
 - COTS and in-house procurements
 - Pushing the boundaries of CubeSat capabilities
 - 2.5-year interplanetary mission
 - Extensive design, analysis, and testing has been performed to-date to address technical challenges
- High-Level Forward Schedule
 - Flight System integration starts Fall 2017
 - Delivery (to storage) in Spring 2018
 - Manifested on SLS EM-1 for ~2019 deep space flight opportunity
 - NEA flyby anticipated in ~2022



Thank you!

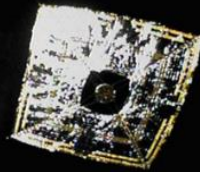
Backup

Brief History of Solar Sailing

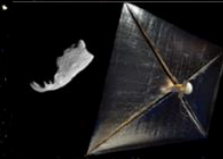


Solar sails derive thrust by reflecting sunlight and therefore never run out of fuel, enabling many heretofore impossible robotic missions.

IKAROS
(JAXA -2010)



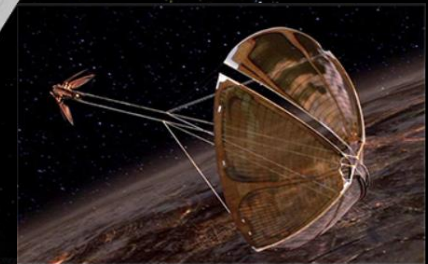
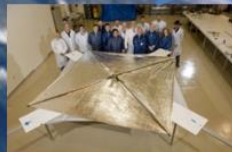
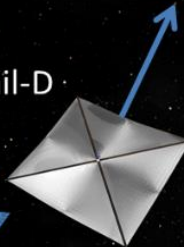
85 m² NEA Scout



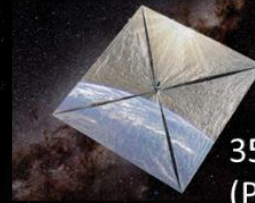
400 m² ground demos
(MSFC Program
Management 2005)



10m² NanoSail-D
(MSFC -2010)



35 m² LightSail-A
(Planetary Society)



Flight System Overview

Mission Concept	<ul style="list-style-type: none"> Characterize a Near Earth Asteroid with an optical instrument during a close, slow fly-by
Payload	<ul style="list-style-type: none"> Upgraded OCO-3 Context Camera
Mechanical & Structures	<ul style="list-style-type: none"> "6U" CubeSat form factor <14 kg total launch mass Modular flight system concept
Propulsion	<ul style="list-style-type: none"> ~80 m² aluminized Kapton solar sail (based on NanoSail-D2)
Avionics	<ul style="list-style-type: none"> Radiation tolerant LEON3-F7 architecture
Electrical Power System	<ul style="list-style-type: none"> Deployable solar arrays with XTJ GaAs cells (~56 W EOL at 1 AU solar distance) 6.2 Ahr battery (3S2P 18650 Lithium Cells) 9 – 12.5 V unregulated, 5 V regulated
Telecom	<ul style="list-style-type: none"> JPL Iris 2.1 X-band transponder, supports Doppler, ranging, and D-DOR 2 pairs of INSPIRE-heritage LGAs (Rx/Tx) Microstrip array MGA (Tx): ~1 kbps to 34-m DSN at 0.75 AU
Attitude Control System	<ul style="list-style-type: none"> Nano star tracker, coarse sun sensors, and MEMS IMU for attitude determination 15 mNm-s (x4) reaction wheels Active mass translation system R-236fa (refrigerant gas) RCS system

